Papers and Originals

Social Class Gradients and Serum Uric Acid in Males and Females

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Summary: The relation between serum uric acid and social class is examined by sex among 910 persons in Wensleydale, Yorkshire, 321 persons in Watford, Hertfordshire, and 1,213 persons in New Haven, Connecticut, all of whom were drawn from the general population. Among the men of Wensleydale there is a tendency of marginal significance at the 5% level for serum uric acid to increase with decreasing social class; in the New Haven women this same trend is significant at the 2·5% level; no trend was found among any of the other four sex-specific groups. Age did not account for the patterns observed. The difference between these findings and those of several studies from the United States is consistent with the view that both serum uric acid levels and gout are under multifactorial control.

Introduction

Since the dawn of medical science it has been repeatedly stated that gout is a disease of the rich and the overindulgent. This traditional dogma has never seriously been questioned, and indeed some recent historical and epidemiological studies seem to support it (Rodnan, 1961; Popert and Hewitt, 1962; Acheson and O'Brien, 1968). Brooks and Mueller (1965) go so far as to say that "a tendency to gout is a tendency to the executive suite."

Since raised serum uric acid is so commonly found in gout, it might reasonably be expected that serum uric acid levels would tend to be highest among the well-to-do in social class I and lowest among the less fortunate in social class V. Evidence in favour of this supposition does exist, but we present below three substantial sets of data which indicate that in three very different communities the serum uric acid either shows no strong social class dependence or may even be highest among the poorest members of the community. Neither the Wensleydale nor the Watford data have previously been submitted to this analysis, though those from New Haven have been published elsewhere in this form (Acheson and O'Brien, 1966).

Material and Method

Populations

Wensleydale, Yorkshire.—A rural population devoted mainly to sheep-rearing lives in this hilly region of Northern England. The sample studied was defined with the help of the electoral roll, and takes into account, on the basis of area, half of Hawes, the market town, and half of the surrounding villages and farms. In all, 1,081 persons aged 15 years and over were enumerated. The area and its population are described in much more detail by Bremner (1961).

Watford, Hertfordshire.—This town is on the northern outskirts of London and is concerned with light industry. Four streets were taken at random, and all the inhabitants aged 15 years and over were asked to co-operate. A private census indicated that the total population at risk in this age range was 496.

New Haven, Connecticut.—This is a small town on the coast of Southern New England which is the seat of Yale University and has some light industry. Full details of the method of selecting the study population are given in another paper (Acheson, 1968). Briefly, the adult population from six areas of the city was invited to co-operate in an extensive survey of joint disease; the 1,213 whose data are presented here represent 51% of the total enumerated population of 2,389.

Serum Uric Acid

The uric acid content of the sera from the two English populations was estimated by the enzymatic method of Liddle *et al.* (1959). In New Haven it was estimated by a modification of Folin's method (Oser, 1965) with an AutoAnalyzer from a specimen of venous blood which had been collected in a dry sterile tube and centrifuged within 12 hours. It is known that values determined this way exceed those determined by the former by 0·2 to 0·4 mg./100 ml. (O'Sullivan *et al.*, 1965; Acheson and Chan, 1969).

Social Class

In the two English surveys the Registrar General's classification (General Register Office, 1950) was used to determine social class. In New Haven it was graded by the method of Hollingshead (1957), which is specifically designed to reproduce, as closely as possible, in New Haven, Connecticut, the classification of the Registrar General.

Results

Serum Uric Acid.—The mean and standard deviations for serum uric acid values are given by sex and social class in the Table, together with the number of persons in each social class group and their average age. It can be seen that for all three sets of data for females, apart from the four women in social class I in Wensleydale, the tendency is for serum uric acid to increase as social class falls from I to V, and that this tendency is statistically significant at the 2·5% level in New Haven. For the Wensleydale males the trend, this time of marginal significance, is also for serum uric acid to be highest

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Serum Uric Acid and Age in Three Populations by Social Class

Social Class	Wensleydale					Watford					New Haven*			
	n	Serum Uric Acid		Age		n	Serum Uric Acid		Age		n	Serum Uric Acid		Age
		Mean	S.D.	Mean	S.D.		Mean	S.D.	Mean	S.D.		Mean	S.D.	Mean
						Males								
I	3	4·83	1·53	63·3	15·3	16	4·78	1·12	46·8	14·0	99	6·50	1·36	50·3
II	243	4·62	0·91	43·2	17·8	20	5·22	1·40	46·0	15·4	79	6·25	1·36	45·4
III	85	4·56	0·80	46·0	17·1	101	5·06	1·25	44·3	18·2	133	6·43	1·29	48·0
IV	90	4·79	0·94	43·4	19·2	13	5·00	0·87	40·8	20·2	128	6·26	1·42	46·9
V	14	5·25	0·96	48·0	12·3	8	4·94	0·94	55·0	16·9	95	6·38	1·43	48·9
Total	435	4·66	0·91	45·0	17·8	158	5·04	1·21	45·0	17·6	534	6·37	1·36	47·9
F D.F. P		2·40 4 : 430 ≃0·05					0·32 4 : 153					1·37 1 : 533		
						Females								
I	4	4·75	1·55	62·5	12·6	15	4·17	1·32	48·0	14·0	111	4·61	1·09	48·0
II	259	3·85	0·89	45·3	17·4	21	4·05	1·00	46·7	15·4	103	4·59	1·08	43·3
III	112	3·92	0·81	46·7	19·4	109	4·16	1·20	42·4	18·2	144	4·60	1·19	47·2
IV	90	4·01	0·81	52·4	19·8	11	4·36	0·87	54·5	20·2	166	4·66	1·19	45·2
V	10	4·15	0·91	43·0	14·5	7	5·07	1·57	54·2	16·9	155	4·96	1·39	48·0
Total	475	3·91	0·87	47·2	18·4	163	4·20	1·19	44·8	17·6	679	4·72	1·20	46·4
F D.F. P		1·73 4 : 470					1·12 4 : 158					5·11 1 : 678 <0·025		

* The earlier analysis of the New Haven data took age and haemoglobin into account (see Acheson and O'Brien, 1968), so that F with one degree of freedom measures the significance of the partial regression of serum uric acid on social class.

among the least well off—there are only three men in social class I—but in Watford and New Haven there is no trend at all. As the Table shows, this lack of association in Wensleydale and Watford cannot be attributed to systematic differences in the ages of the people in the various social classes. In New Haven the analysis specifically accounted for any effect of age —and coincidentally for the effect of haemoglobin too (Acheson and O'Brien, 1966, 1968).

Gout.—Gout does show a significant tendency to be commonest among the prosperous in New Haven (Acheson and O'Brien, 1968) ; since there were only four cases in Watford (all in class III) and none in Wensleydale it is not possible to draw conclusions about its social class distribution in those communities.

Discussion

Some of the data presented above from Wensleydale were included among those on which Popert and Hewitt (1962) based their excellent study of the epidemiology of gout and hyperuricaemia in rural and urban populations. Despite the fact that their work has since been cited as showing that serum uric acid is social-class-dependent, Popert and Hewitt themselves made no such claim—though they did discuss at some length the social class association they found for gout.

Sociologists differ in their definitions of social class. Weber (1953) considered a class to be a group of people with similar opportunities in life, and, like Gordon (1963) and indeed Marx before him, stressed that opportunity must have an economic basis. Hollingshead (1957), however, in his pioneer studies in New Haven, found that the education and occupation of the chief money-maker in a family were so closely associated with family income that accurate classification could be achieved without taking direct cognizance of economic status at all. The Registrar General does not even take education into account in his system, which makes the assumption that occupation alone will identify the social and economic stratum of society to which a man and his family belong. At best, therefore, social class is one of the rougher epidemiological tools.

In a series of studies among the employees of various industries, among medical students, and among adolescents at high school from various parts of the United States, Cobb and his associates (Cobb *et al.*, 1961 ; Cobb, 1963 ; Dunn *et al.*, 1963) found that there was a tendency for those in the higher social classes to have the higher serum uric acid. They argued that the serum uric acid induced "intelligence and excellence of all-round performance," and by so doing stimulated those in whom these qualities are high to improve their social class. Subsequently other workers in the same group modified this claim by stating their belief that social class gradient of serum uric acid has a much stronger relationship to "drive, achievement, and leadership" than it has to high scores in intelligence tests (Brooks and Mueller, 1965 ; Kasl *et al.*, 1966). Higher than average serum uric acid levels have been reported by Montoye *et al.* (1967) among business executives attending a summer school in the University of Michigan, and similar patterns have been observed in the population of Tecumseh, Michigan (H. J. Dodge, and W. M. Mikkelsen, personal communication, 1964).

Whatever their explanation, these results are certainly at odds with those presented here. Apart from the intrinsic difficulties presented by the hypothesis that increased levels of serum uric acid can stimulate and sustain either improved intelligence or increased drive and ambition, there are several possible explanations for these contradictory findings. Though it is true that the various groups considered by Cobb and his colleagues come, by any definition, from differing social classes, it cannot be claimed that they were selected in such a way as to be representative of those classes. The differences between their results and ours could therefore be a result of sampling, but this objection cannot be levelled at the Tecumseh survey. The differences are certainly consistent with the view that serum uric acid levels and the aetiology of gout are under multifactorial control (Kellgren, 1964 ; McCarty, 1964). Indeed, as one of us has argued elsewhere (Acheson, 1969 ; Acheson and Florey, 1969), there is increasing evidence that, while one determinant of serum uric acid may be dominant in certain populations, the same factor may play an unimportant part elsewhere. This could readily explain how a social class association with serum uric acid can be absent in some populations yet can be present in differing forms in others.

Our data lead us to a second conclusion—namely, that some of the social class factors responsible for gout are quite distinct from those which affect the level of serum uric acid. In New Haven the trend for the prevalence of gout took the opposite direction to the trend for serum uric acid, and in Watford the four clinical cases were in social class III, among whom serum uric acid levels were very close to the average for the entire Watford population.

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White Blood Count in Patients on Regular Haemodialysis

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Summary: Total white cell, neutrophil, and lymphocyte counts were compared in patients with chronic renal failure treated successively by conservative means (low-protein diet), regular haemodialysis, and renal allotransplantation. The lowest total white cell and neutrophil counts and the highest lymphocyte counts were found in patients on regular haemodialysis. A rapid fall in neutrophil count during the first half-hour of dialysis and a more gradual fall between the first and sixth hours were observed. Adherence of neutrophils and mononuclear cells to the cuprophane (PT 150) dialysis membrane has been shown.

Introduction

The total white cell count has been reported to be high in cases of acute renal failure and high or normal in cases of chronic renal failure; neutrophil leucocytosis and lymphopenia is common to both (Jensson, 1958; Riis and Stougaard, 1959). The cause of lymphopenia in uraemia is obscure, as is also neutrophil leucocytosis in the absence of infection. It may be that substances retained in the body because of renal failure depress lymphopoiesis and stimulate granulopoiesis, though the identity of such substances is unknown. Little is known of the behaviour of the white cells in patients on regular haemodialysis, where uraemia is well controlled, though infections are common in such patients.

This paper is a retrospective study of the white blood count in patients with chronic renal failure during three periods: on conservative treatment (low-protein diet), on regular haemodialysis, and during the early stage after renal allotransplantation. In addition the acute effect of haemodialysis on the white blood count has been examined.

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Material and Methods

Twenty patients (10 male and 10 female) were studied. Their mean age was 32 years, with a range from 18 to 46. The underlying disease was chronic pyelonephritis in 10, chronic glomerulonephritis in five, two were anephric (bilateral nephrectomy), one had polycystic kidneys, one familial nephritis, and one a solitary hydronephrotic kidney. The total white blood count and the differential were studied in three periods: on restricted protein diet (13 patients), on haemodialysis (all 20 patients), and during the early stage (first four months) after renal transplantation (12 patients).

The first and third periods of study extended over at least four months, seven and eight patients respectively being excluded because this criterion was not fulfilled. Patients on haemodialysis were studied for at least six months. During the first period the patients were on a modified Giordano-Giovannetti diet, usually containing about 20 g. of protein. During the second period they were dialysed overnight (beginning dialysis at about 6 to 8 p.m. and ending 12 hours later) twice-weekly by means of Kiil dialysers with Lucas monitors and a single-pass automatic dialysate supply. The membranes used were cuprophane PT 150. Heparin was given during dialysis in a priming dose of 10,000 international units (i.u.) followed by 5,000 i.u. every three hours. Whole-blood clotting-time during dialysis was maintained over 20 minutes. During the last hour of dialysis the dialyser was tipped vertically in order to reduce the retention of blood between the membranes.

All patients on dialysis were on a diet containing 0·7–0·9 g. of protein per kg. body weight and were taking folic acid